HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Big Beef Creek Summer Chum Salmon Reintroduction
Species or Hatchery Stock:	Summer chum salmon, *Oncorhynchus keta*, Quilcene stock
Agency/Operator:	Washington Department of Fish and Wildlife
Watershed and Region:	Big Beef Creek, Hood Canal, Puget Sound, Washington State
Date Submitted:	May 12, 2000
Date Last Updated:	March 26, 2001

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program. Big Beef Creek summer chum salmon reintroduction

1.2) Species and population (or stock) under propagation, and ESA status.
Summer chum salmon, *Onchorhynchus keta*, Quilcene stock;
Hood Canal Summer Chum ESU: Threatened

1.3) Responsible organization and individuals

Lead agency contact:.

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Agency or Tribe:	Washington Dept. of Fish and Wildlife (WDFW)
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On-site operations staff lead:

Name (and title):	
Agency or Tribe:	Washington Dept. of Fish and Wildlife (WDFW)
Address:	WDFW - c/o U of W, Big Beef Creek Fish Research Station; 9744 Manley Road N.W.; Seabeck, WA 98380
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Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:
The summer chum re-introduction program at Big Beef Creek is centered at the University of Washington's fish research station that covers the lower mile of the stream. During 1999 and 2000 significant infra-structural improvements were made at this facility. Funds to perform this work came from Kitsap County and from Salmon Recovery Funds provided to Kitsap County. These dollars were used to renovate an existing chum salmon spawning channel, repair dikes and roads, and install a new production well at the research station. Moreover, Kitsap County has submitted an additional request to the Salmon Recovery Funding Board (SRFB) to cover the costs of completing the spawning channel restoration work that was started in 1999; this request is currently under consideration by the SRFB. The Hood Canal Salmon Enhancement Group provided significant engineering and supervision help during this construction period. The summer chum salmon eggs used at Big Beef Creek are annually supplied to the site by the U.S. Fish and Wildlife Service from their Quilcene National Fish Hatchery. Staff from this organization also are providing technical support to the project and in 1999, the service contributed manpower and heavy equipment to help renovate the

spawning channel and surrounding dikes. The University of Washington, under contract, furnishes staff support, land, incubation and rearing water, and electricity which is used to thermally mark all the summer chum produced by the project. U of W graduate student and faculty involvement with research projects directed toward summer chum recovery may occur in the future. The Point-No-Point Treaty Council and tribes are providing technical support, particularly in the realm of habitat improvement, land use issues in the Big Beef Creek watershed, and summer chum recovery in the Hood Canal ESU.

1.4) Funding source, staffing level, and annual hatchery program operational costs.

Source: WDFW

Staffing: Oversight support and staffing are funded by WDFW, staff support includes a Research Scientist, Fish Biologist, Environmentalist, Scientific Technicians, Habitat Biologist, and Fish Health Specialist.

Operational costs: $60,000 per year (includes a personal service contract to the U of W to pay for water, space, electricity, and staff time)

1.5) Location(s) of hatchery and associated facilities.

Broodstock collection: Quilcene Bay and Quilcene National Fish Hatchery

Quilcene National Fish Hatchery: PSC hatchery location code 3F10412; located on Big Quilcene River (17.0012) at RM 2.8; spawning and initial incubation; eyed eggs transported to Big Beef Creek Hatchery.

Big Beef Creek Hatchery: PSC hatchery location code 3F10412 150389 H; located on Big Beef Creek (15.0389) at RM 0.1; incubation, rearing, and release; broodstock collection beginning with brood year 2000.

1.6) Type of program.

Integrated Recovery

1.7) Purpose (Goal) of program.

Restoration. The goal of this program is to reintroduce an extirpated summer chum salmon population to Big Beef Creek using the Quilcene stock; and to restore a healthy, natural, self-sustaining population of summer chum salmon in Big Beef Creek that will eventually develop genetic characteristics specifically suited for Big Beef Creek.

1.8) Justification for the program.

Big Beef Creek summer chum salmon was identified as an extinct stock and selected as a reintroduction candidate in the Summer Chum Salmon Conservation Initiative (SCSCI) developed by Washington Department of Fish and Wildlife and Point-No-Point Treaty Tribes (WDFW et al. 2000). This program is fully consistent with the rationale, intent, and implementation of the supplementation and reintroduction approach identified in the SCSCI. The following is taken from the SCSCI:

"Supplementation is viewed as an effective tool, in combination with other management

actions, for restoring natural production to healthy levels within the Hood Canal/Strait of Juan de Fuca summer chum ESU. By the early 1990s, summer chum populations had declined to such low levels that the risk of extinction to portions of the ESU on the short term was high. Furthermore, with the recent extirpation of four populations, the need for hatchery-based actions was identified to reintroduce summer chum into vacant habitat that, based on stock assessment data, appeared unlikely to be colonized naturally within a reasonable time frame. The need to quickly boost the population sizes above critically low levels, and the fact that some factors limiting production, such as harvest and habitat degradation, were in the process of being addressed also contributed to the decision to use supplementation.

The intent of supplementation efforts within this ESU is to reduce the short term extinction risk to existing wild populations and to increase the likelihood of their recovery to a healthy status. These objectives can be accomplished through the establishment of supplemented populations using indigenous brood stock, and through reintroduction of appropriate populations into streams now lacking summer chum. In keeping with the intended ephemeral nature of this form of artificial production, the proposed supplementation strategy will be limited in duration and designed to help maintain the populations while potential factors for decline are identified and being addressed. Monitoring and evaluation activities proposed for the programs will provide important new scientific information regarding the effectiveness of supplementation as it relates to chum salmon. Contribution to the re-establishment of naturally functioning ecosystems through the recovery or restoration of summer chum populations, is also an intent.

The supplementation focus at this time is on recovery of “at risk” stocks and reintroduction of extirpated populations. This current emphasis is in response to the generally poor condition of the stocks within the ESU. For “at risk” populations chosen through this program for supplementation, hatchery production of fed fry of large size relative to natural fry, released at the proper migration time, will provide a survival advantage that will improve the status of the populations more rapidly than is possible through natural production alone. The immediate objective for these populations will be to boost the population abundance as quickly as possible, increasing natural spawner densities to sustainable levels that will alleviate the risk of extinction to the populations. For selected, extirpated populations, seeding of usable habitats will be accomplished through reintroduction strategies developed specifically for each recipient watershed. Reintroduction planning strategies will include selection of the most appropriate donor stock, acclimation to the recipient location, and release of fed chum fry to maximize the likelihood for the establishment of a population”.

1.9) List of program “Performance Standards”.

The following are objectives for the re-establishment of a summer chum population in

Big Beef Creek, as presented in the SCSCI (WDFW et al. 2000):

Objective 1: Release Quilcene River-origin fry into the historical habitat of the Big Beef Creek population. Monitor adult returns from the initial releases and evaluate the natural spawning success of these adults, where success is measured by return of naturally produced adult off-spring.

Objective 2: Determine if a self-sustaining, viable population has been established through the reintroduction program from QNFH.

Objective 3: Develop and maintain, for up to 12 years (beginning in 1996), a population comprised of supplemented and naturally spawning fish using hatchery and wild-origin broodstock.

Objective 4: Implement a study to identify and compare wild and hatchery-origin chum spawner productivity, and survival from out-migration to adult return. monitor, evaluate and annually report the effectiveness of the reintroduction program, as measured by consistency with criteria set forth in the SCSCI.

1.10) List of program "Performance Indicators", designated by "benefits" and "risks."

This program is fully consistent with the intent and implementation of the monitoring and evaluation component for supplementation and reintroduction programs identified in the SCSCI. The monitoring and evaluation program in the SCSCI responds to concerns regarding the uncertainty of summer chum supplementation and reintroduction effects by addressing the following four elements :

1. The estimated contribution of supplementation/reintroduction program-origin chum to the natural population during the recovery process;

2. Changes in the genetic, phenotypic, or ecological characteristics of populations (target and non-target) affected by the supplementation/reintroduction program;

3. The need and methods for improvement of supplementation/reintroduction activities in order to meet program objectives, or the need to discontinue a program because of failure to meet objectives; and

4. Determination of when supplementation has succeeded and is no longer necessary for recovery.

1.10.1) "Performance Indicators" addressing benefits.

Element 1: Estimate the contribution of supplementation/reintroduction program-origin chum to the natural population during the recovery process.

1. Differentially mark all hatchery-origin summer chum fry to allow for distinction from natural-origin fish upon return as adults on the spawning grounds. This will be accomplished by otolith (thermal) marking or by other permanent, effective methods.

2. Conduct spawning ground surveys throughout the summer chum return to enumerate spawners, and to collect information regarding fish origin (via random sampling of fish heads for otoliths), and age class composition through scale sampling.

3. Estimate the number of naturally spawning hatchery-origin summer chum contributing to each supplemented population's annual escapement.

4. Conduct focused studies to help identify productivity levels (swim-up fry per adult spawner) that can be expected for hatchery-origin fish spawning in the wild (Big Beef Creek research). Compare these estimates with fry per spawner levels reported for wild summer chum salmon spawners in the region, or in other regions.

a. Enumerate natural escapement of F1 generation reintroduced fish to a previously extirpated stream (preferably number passed above rack).
b. Use F1 chum collected as broodstock as a random sample of the return.
c Use age structure, fecundity, and sex ratio data from collected F1 adults to estimate egg deposition in the stream. Determine egg retention of spawned out fish.
d. Enumerate progeny (out-migrating fry) of F1 adults to estimate egg to fry survival and to establish the baseline number of fry contributing to subsequent brood year returns.
e. Capture, sample and pass upstream resultant F2 generation spawners (three, four, and five years later) to assess survival and reproductive success of naturally-spawning hatchery-origin fish.

Element 4: Collect and evaluate information on adult returns.

1. Commencing with the first year of returns of progeny from naturally-spawned, hatchery-origin summer chum, evaluate results of spawning ground surveys and age class data collections to:

a. Estimate the abundance and trends in abundance of spawners;
b. Estimate the proportion of the escapement comprised by chum of hatchery lineage, and of wild lineage;
c. Through mark sampling, estimate brood year contribution for hatchery lineage and wild-origin fish.

Using the above information, determine whether the population has declined, remained stable, or has been recovered to sustainable levels. The ability to estimate hatchery and wild proportions will be determined by implementation plans, budgets, and assessment priorities.

1.10.2) "Performance Indicators" addressing risks.

Element 1: Estimate the contribution of supplementation/reintroduction program-origin chum to the natural population during the recovery process.

1. Monitor escapements of non-supplemented populations to determine the level of straying of supplementation program-origin fish to other drainages.

Element 2: Monitor and evaluate any changes in the genetic, phenotypic, or ecological characteristics of the populations presently affected by the supplementation program.

1. Collect additional GSI data (allozyme or DNA-based) from regional summer chum adult populations to determine the degree to which discrete populations exist in the individual watersheds.
2. Continue GSI allozyme collections of summer chum spawners throughout the region for comparison with past collections to monitor changes in allelic characteristics, and with the intent to assess whether the supplementation program has negatively affected the genetic diversity of natural populations.
3. To assess the effect of past or on-going supplementation activities on the heterozygosity of target populations, collect tissue samples from representative juveniles for GSI analysis, allowing for a comparison of the genetic diversity of progeny samples to the existing baseline population profile.
4. Continue collecting and archiving DNA samples for future analysis.

Element 3: Determine the need, and methods, for improvement of supplementation or reintroduction operations or, if warranted, the need to discontinue the program.

1. Determine the pre-spawning and green-egg to released-fry survivals for each program at various life stages.
   a. Monitor growth and feed conversion for summer chum fry.
   b. Determine green-egg to eyed-egg, eyed-egg to swim-up fry, and swim-up fry to released fry survival rates for summer chum.
   c. Maintain and compile records of cultural techniques used for each life stage, such as: collection and handling procedures, and trap holding durations, for chum broodstock; fish and egg condition at time of spawning; fertilization procedures, incubation methods/densities, temperature unit records by developmental stage, shocking methods, and fungus treatment methods for eggs; ponding methods, start feeding methods, rearing/pond loading densities, feeding schedules and rates for juveniles; and release methods for fed fry.
   d. Summarize results of tasks for presentation in annual reports.
   e. Identify where the supplementation program is falling short of objectives, and make recommendations for improved fry production as needed.
2. Determine if broodstock procurement methods are collecting the required number of adults that represent the demographics of the donor population with minimal injuries and

stress to the fish.

a. Monitor operation of adult trapping operations, ensuring compliance with established broodstock collection protocols.
b. Monitor timing, duration, composition, and magnitude of the Big Beef Creek summer chum salmon run.
c. Maintain daily records of trap operation and maintenance (e.g. time of collection), number and condition of fish trapped, and environmental conditions (e.g. river stage, tide, water temperature).
d. Collect biological information on collection-related mortalities. Determine causes of mortality, and use carcasses for stock profile sampling, if possible.
e. Summarize results for presentation in annual reports. Provide recommendations on means to improve broodstock collection, and refine protocols if needed for application in subsequent seasons.

3. Monitor fish health, specifically as related to cultural practices that can be adapted to prevent fish health problems. Professional fish health specialists supplied by WDFW or USFWS will monitor fish health.

a. Fish health monitoring will be conducted by a fish health specialist. Significant fish mortality to unknown causes will be sampled for histopathological study.
b. The incidence of viral pathogens in summer chum broodstock will be determined by sampling fish at spawning in accordance with procedures set forth in the "Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State (WDFW 1996).
c. Recommendations on fish cultural practices will be provided on a monthly basis, based upon the fish health condition of chum fry.
d. Fish health monitoring results will be summarized in an annual report.

Element 4: Collect and evaluate information on adult returns.

This element will be addressed through consideration of the results of previous "Elements 1., 2., and 3.", and through the collection of information required under adaptive criteria that will be used as the basis for determining when to stop a supplementation or reintroduction program.

1. Collect age, sex, length, average egg size, and fecundity data from a representative sample of broodstock used in each supplementation program for use as baseline data to document any phenotypic changes in the populations.

2. Compare newly acquired electrophoretic analysis data reporting allele frequency variation of returning hatchery and wild fish with baseline genetic data. Determine if there is evidence of a loss in genetic variation (not expected from random drift) that may have resulted from the supplementation program.

1.11) Expected size of program.

1.11.1) Proposed annual broodstock collection level (maximum number of adult fish). From 1996 through 1999, summer chum propagated for this program were progeny of broodstock collected from Quilcene summer chum salmon population. It is proposed to collect 250 males (200 from the Quilcene Bay fishery, 50 from the hatchery rack) and 250 females (200 from the bay fishery, 50 from the hatchery rack) for the combined Quilcene supplementation and Big Beef Creek reintroduction programs.

Beginning with brood year 2000, it is proposed to collect broodstock from summer chum adults returning to Big Beef Creek; 100 adults (50 males and 50 females) will be collected. If insufficient numbers of adult summer chum return to Big Beef Creek, broodstock collection from Quilcene Bay and QNFH may continue to provide broodstock for the Big Beef Creek program.

1.11.2) Proposed annual fish release levels (maximum number) by life stage and location. (*Use standardized life stage definitions by species presented in* Attachment 2).

Life Stage	Release Location	Annual Release Level
Eyed Eggs		
Unfed Fry		
Fry	Big Beef Creek	103,000
Fingerling		
Yearling		

1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.
In 1999, four age 3 summer chum adults returned to Big Beef Creek from the 1996 brood year release of 184,000 fry. In 2000, estimated return was 20 summer chum , comprised of 11.1% age 2, 77.8% age 3, and 11.1% age 4 fish (pers. comm., T.H. Johnson, WDFW). Data are from WDFW field notes recorded at Big Beef Creek during the fall of 1999 and 2000. .

1.13) Date program started (years in operation), or is expected to start.
1996; in fourth year of operation

1.14) Expected duration of program.
This program is fully consistent with the standards presented in the SCSCI. Expected maximum duration is three generations (12 years); 8 years remaining

1.15) Watersheds targeted by program.
Big Beef Creek (WRIA 15.0389).

1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.

Alternative actions considered and implemented include integration with habitat and harvest recovery measures identified in the SCSCI.

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS.

2.1) List all ESA permits or authorizations in hand for the hatchery program.

None in hand; ESA listings are new in this area.

2.2) Provide descriptions, status, and projected take actions and levels for ESA-listed natural populations in the target area.

2.2.1) Description of ESA-listed salmonid population(s) affected by the program.

The following is paraphrased from life history information for Hood Canal and Strait of Juan de Fuca summer chum presented in the Summer Chum Salmon Conservation Initiative (WDFW et al. 2000):

Hood Canal and Strait of Juan de Fuca summer chum populations are one of three genetically distinct lineages of chum salmon in the Pacific Northwest region; and were designated as an evolutionarily significant unit (ESU) based upon distinctive life history and genetic traits. The uniqueness of the summer chum life history is best characterized by their late summer entry into freshwater spawning areas, and their late winter/early spring arrival in the estuaries as seaward-migrating juveniles. Reproductive isolation has been afforded by a significantly different migration and escapement timing and geographic separation from other chum stocks.

Summer chum spawning occurs from late August through late October. Eggs eye in nests after about 4 to 6 weeks incubation and hatch about 8 weeks after spawning. Fry emerge from redds, usually during darkness, between February and late May and immediately emigrate downstream to estuarine areas. Summer chum fry initially inhabit nearshore areas and occupy sublittoral seagrass beds for about one week and are thought to be concentrated in the top few meters of the water column both day and night. Upon reaching a size of 45-50 mm, fry move to deeper offshore areas. Migrating at a rate of 7-14 km per day, the southernmost out-migrating summer chum fry population in Hood Canal would exit the Canal 14 days after entering seawater (90% of population exits by April 28 each year, on average); and Strait of Juan de Fuca summer chum would exit the Discovery Bay area 13 days after entering seawater (90% completion by June 8 each year, on average).

Summer chum mature primarily at 3 and 4 years of age. The southerly ocean migration down the Pacific Northwest coast from rearing areas in the northeast Pacific Ocean likely commences in mid-July and continues through at least early September. Adults enter terminal areas from early August through late September, with spawning ground entry timing in Hood Canal from late August through mid-October and in Strait of Juan de Fuca from early September through mid-October. Hood Canal and Strait of Juan de Fuca summer chum typically spawn soon after entering freshwater in the lowest reaches of their natal streams. Low summer-time flows likely have acted to confine summer chum spawning in this region to the lowest reaches.

- Identify the ESA-listed population(s) that will be directly affected by the program.
The program will lead to recovery of Big Beef Creek summer chum salmon which is a stock identified as part of the Hood Canal Summer Chum ESU.

- Identify the ESA-listed population(s) that may be incidentally affected by the program.
The program may incidentally affect chinook salmon in the Puget Sound Chinook ESU (by providing additional prey base for chinook). Both naturally-produced, non-indigenous chinook and hatchery chinook are present in Big Beef Creek, but it is not possible to identify them separately. While it is not possible to reasonably quantify effects, listed chinook may be incidentally (1) affected by trapping operation of adults where fish are captured, handled and released upstream, (2) affected by contact with listed fish during spawner surveys and carcass and mark recovery projects, and (3) sampled as carcasses sampled for otoliths, scales, genetic stock identification, and routine monitoring and evaluation activities.

It is not anticipated that the program will impact bull trout since none are known to be present in the area of the program.

2.2.2) Status of ESA-listed salmonid population(s) affected by the program.

- Describe the status of the listed natural population(s) relative to "critical" and "viable" population thresholds (*see definitions in "Attachment 1").*

The indigenous Big Beef Creek summer chum population was extirpated by the early 1980s, and was therefore designated as "extinct" by the Co-managers in the SCSCI. The founding population from the Quilcene stock was designated as "depressed" in status by the Co-managers. Prior to initiation of the Quilcene NFH supplementation program, the Quilcene stock was rated as at high risk of extinction. However, based on an increasing escapement trend and recent large escapements attributable in large part to the success of the hatchery program, the current extinction risk for the Quilcene stock is rated as low in the SCSCI.

- Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.
Data are not presently available for the natural Big Beef Creek population, but will be collected.

- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.
Source is SCSCI (for 1968-1998), WDFW files (for 1999 and 2000) and U of W files for Big Beef Creek 1968- 1981:

	Big Quilcene River			Big Beef Creek
Return year	Natural	Hatchery	Total	Total
1968	2,797		2,797	100
1969	1,307		1,307	100
1970	655		655	178
1971	1,798		1,798	159
1972	2,067		2,067	177
1973	3,107		3,107	244
1974	795		795	75
1975	1,405		1,405	1152
1976	2,445		2,445	1281
1977	821		821	302
1978	2,978		2,978	680
1979	345		345	191
1980	375		375	123
1981	138		138	90
1982	156		156	0
1983	64		64	0
1984	60		60	22
1985	44		44	0
1986	15		15	6
1987	8		8	0
1988	120		120	0
1989	1		1	0
1990	6		6	0
1991	49		49	0
1992	320	414	734	0
1993	97	39	136	0
1994	349	373	722	0
1995	4,029	491	4,520	0
1996	8,479	771	9,250	0
1997	7,339	535	7,874	0
1998	2,244	544	2,788	0
1999	2,981	172	3,153	4
2000	5,126	504	5,630	20

-Provide the most recent 12 year (e.g.1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.
Not known

2.2.3) <u>Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of listed fish in the target area, and provide estimated annual levels of take</u>

- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.

Listed summer chum salmon adults will be trapped and collected for broodstock from August through October at Big Beef Creek. Other listed summer chum adults will be trapped, handled, and passed upstream during trap operation and this may lead to injury to listed fish through delayed migration and spawning, or delayed mortality as a result of injury or increased susceptibility to predation. The trap is located on private property, accessed through a gate maintained by the property owner. Human disturbance or poaching of other fish held in the trap have not been experienced in the past and the likelihood of this activity taking place in the future is low.

The Hood Canal Salmon Enhancement Group and the University of Washington have had a hatchery program for non-indigenous fall chinook at the Big Beef Creek research station for approximately a decade with an objective of augmenting harvest (for further details see the HGMP for the fall chinook program at Big Beef Creek). In 1999, it was estimated that several thousand chinook returned to Big Beef Creek. Because of the proclivity for chum salmon to "mill" for several weeks in estuary areas before entering their natal streams to spawn, they are particularly susceptible to terminal estuarine fisheries. In 1999, no summer chum were observed harvested in the Big Beef estuary, however, large numbers of fall chinook returning to Big Beef Creek may attract fishers to the stream and thereby increase the likelihood of inadvertently taking summer chum salmon. Plans are underway to further restrict harvest in this area which should help alleviate this by-catch problem.

Some of the non-indigenous fall chinook returning to Big Beef Creek have been allowed to spawn naturally in the stream below the weir. This area will also be a spawning site for summer chum once they become re-established in the basin and there is a possibility that redd superimposition may occur. This portion of the stream, however, is subject to severe flooding and hence egg-to-fry survivals are expected to be very low or non-existent even without superimposition effects. Beginning in 2000, a concerted effort will be made to prevent non-indigenous fall chinook from spawning naturally in the Big Beef basin. The simultaneous presence of fall chinook and summer chum in the stream could have some deleterious and beneficial consequences. Because of the fall chinook program, trapping and holding facilities are available and personnel are available to capture and hold brood stock. Summer chum salmon could be affected by the trapping operation of adults. In addition, the station has limited incubation and fish rearing space and water and

the non-indigenous hatchery chinook program could compromise the ability to successfully incubate and rear summer chum. Such conflicts over space and water are currently being addressed and they should not play a prominent role in the summer chum program in the future.

Once summer chum abundance becomes large enough, adult fish will be passed over the weir and allowed to spawn naturally in the lower portions of Big Beef Creek. Natural egg-to-fry survivals in the stream will probably be low because of the proclivity of the stream to flood and move a substantial portion of its streambed. SRFB monies are being used to improve the habitat in the basin and it is hoped that incubation conditions will be improved over time. Some incubation and rearing mortality of cultured fish will occur, in aggregate they should not exceed 20% from fertilization to release as a 1 to 1.5 gram fry and most likely will range between 5 to 10%. Risk aversion minimize the likelihood for the take of listed summer chum during culture (see section 5.8). No take of other listed salmonids due to these activities is anticipated.

Physical harm of reared summer chum at release (March through May) due to handling or increased susceptibility to predation at release has a potential to take listed summer chum; it has not been measured but is believed to be minimal to date. In an effort to minimize predation at release, the reared fish are liberated under the cover of darkness on an ebbing tide. Previous studies of chum salmon survival that have taken place in Hood Canal have indicated that rearing the fish up to 1 to 1.5 grams will significantly increase their post-release survival. This information was used to develop our release size standard. Other studies that documented the out-migration timing of these fish were used to establish when the fish should be liberated into Hood Canal. All the cultured fish produced from this program will be thermally marked so that we can evaluate their survival and also refine the cultural practices and release strategies employed. No take of other listed salmonids is anticipated.

Contact with summer chum during spawner escapement surveys (August through October), carcass recovery programs (September and October), and other monitoring and evaluation programs have the potential to take listed summer chum, but care will be taken not to harm, harass or otherwise disturb summer chum spawners while they are reproducing in Big Beef Creek.

- Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.

A supplementation program was initiated on Big Quilcene River in 1992 and a reintroduction program was started on Big Beef Creek in 1996. Since initiation of the programs (1) the number of summer chum adults trapped, handled, collected for broodstock at Quilcene has ranged from 39 to 535 fish each year; 4 summer chum salmon were seen and captured at Big Beef Creek in 1999 (2) the number of fry released has ranged from 25,000 to 613,000 fish each year in Big Quilcene River and has ranged from 40,000 to 214,000 fish each year in Big Beef Creek; and (3) the mortality during the incubation and rearing stages was carefully appraised during the 1998/1999 incubation and rearing period for the Big Beef program. Mortality was 7.21% from fertilization to the eyed-egg stage, 0.8% from eyeing to emergence, and 0.3% from emergence to release; total mortality was 1.1% from eyed egg to release at the Big Beef Creek facilities. Although not completely analyzed, the 1999/2000 fish have experienced similar high survival rates at Big Beef Creek.

- Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).

For listed summer chum salmon, projected annual take levels are (1) 11,500 eggs or fry mortality during incubation, rearing, and release (based on 114,500 eggs, 90% survival egg to release, and 103,000 fry release); (2) 250 adults removed for broodstock from Quilcene Bay or QNFH for Quilcene and Big Beef Creek combined; or up to 95 adults removed for broodstock from Big Beef Creek (based on 114,500 eggs, 3000 eggs/female, 1.5 males/female); (3) unintentional lethal take of 30 adults during trapping, holding prior to spawning or release (based on 2% loss of 1500 adults trapped); (4) 1375 adults associated with trapping operation where fish are captured, handled and released upstream (based on 1500 adults trapped minus broodstock and unintentional lethal take); (5) 500 adults associated with disturbance of spawners during spawner surveys, and carcass and mark recovery projects (based on multiple events and average of 1 occurrence/spawner for one-third of 1500 spawners); and (6) 300 carcasses sampled for otoliths, scales, GSI, and other biological information during spawner surveys, broodstocking, and routine monitoring and evaluation activities (based on target sample size of 300). See Table 1.

Both naturally-produced, non-indigenous chinook and hatchery chinook are present in Big Beef Creek, but it is not possible to identify them separately. Hence, it is not possible to reasonably estimate the take of listed chinook. Listed chinook may be incidentally (1) affected by trapping operation of adults where fish are captured, handled and released upstream, (2) affected by contact with listed fish during spawner surveys and carcass and mark recovery projects, and (3) sampled as carcasses for otoliths, scales, genetic stock identification, and routine monitoring and evaluation activities.

- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

The take will be limited since the number of broodstock collected will be consistent with guidelines and protocols in the SCSCI and the number of carcasses collected will be consistent with monitoring and evaluation objectives in the SCSCI. Methods to prevent catastrophic loss during incubation, rearing, and release are in compliance with program operations and protocols in the SCSCI (which includes measures to cull surplus production) and will limit take.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan or other regionally accepted policies (e.g. the NPPC *Annual Production Review* Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

This program is fully consistent with the guidelines, protocols, and implementation of the co-manager's Summer Chum Salmon Conservation Initiative (SCSCI) (WDFW et al. 2000).

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.

This HGMP is consistent with relevant standing orders and agreements. The Puget Sound Salmon Management Plan (PSSMP) and the Hood Canal Salmon Management Plan (HCSMP) are federal court orders that currently control both the harvest management rules and production schedules for salmon in Hood Canal under the *U.S. v. Washington* management framework. The parties to the SCSCI recognize that it may be necessary to modify these plans in order to implement the recommendations that will result from the SCSCI. However, the provisions of the PSSMP and HCSMP will remain in effect until modified through court order by mutual agreement

3.3) Relationship to harvest objectives.

The summer chum supplementation program is integrated with fisheries management measures as defined in the Summer Chum Salmon Conservation Initiative (WDFW et al. 2000). The "base conservation" fishery total harvest rate proposed under the Summer Chum Salmon Conservation Initiative is 10.8% (with a range of 3.3% to 15.3%). These rates reflect incidental fishery harvest levels in Canadian and U.S. fisheries.

3.3.1) Describe fisheries benefitting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.

No directed fisheries on summer chum salmon result from adult fish produced through the Quilcene or Big Beef Creek programs. As noted in 3.3, above, the "base conservation" fishery total harvest rate proposed under the Summer Chum Salmon Conservation Initiative is 10.8% (with a range of 3.3% to 15.3%). These rates reflect incidental fishery harvest levels in Canadian and U.S. fisheries. Exploitation rates on the Quilcene stock reported in the SCSCI have been 97.1%, 88.3%, 99.9%, 99.0%, 95.7%, 40.1%, 19.3%, 19.3%, 5.2%, 2.8%, 3.6%, and 2.9% for the years 1987 through 1998, respectively.

3.4) Relationship to habitat protection and recovery strategies.

The summer chum supplementation program is integrated with habitat restoration and management measures as defined in the Summer Chum Salmon Conservation Initiative (WDFW et al. 2000). The SCSCI provides a standardized approach to determine freshwater and estuarine limiting factors in each summer chum watershed. Habitat factors for decline and recovery for each watershed are described. In addition, at the ESU scale, protection and restoration strategies for each limiting factor for decline are provided. The goal of the habitat protection and restoration strategy is to maintain and recover the full array of watershed and estuarine-nearshore processes critical to the survival of summer chum across all life stages.

3.5) Ecological interactions.

Chum salmon have an unique relationship with other salmonid species that will generally benefit the other species. In most circumstances, because of their small size and relative abundance at out-migration, summer chum fry have a positive impact as prey for other salmonids, including chinook salmon, coho salmon, and coastal cutthroat trout. In turn, chinook and coho salmon and coastal cutthroat could negatively impact the summer chum supplementation program via predation on summer chum fry, but the risk of significant impact is likely to be low. Chum have not been identified as predators on other salmonids and have a low risk of negatively impacting salmonids as predators.

The supplementation program will result in an increase in the number of chum salmon carcasses in freshwater areas and provide a source of nutrients which will benefit other salmonids and non-salmonids.

Supplemented summer chum may compete for food with wild chum fry. This risk will be minimized through the release of supplemented fish at a larger size than the wild fry which should lead to niche separation in the two groups.

SECTION 4. WATER SOURCE

4.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.

Eggs taken from Quilcene stock summer chum adults are incubated to the eyed stage at U.S. Fish and Wildlife Service Quilcene National Fish Hatchery (QNFH). Water rights at the QNFH facility allow for the withdrawal of up to 25 cfs of from the Big Quilcene River and 15 cfs from Penny Creek, a Big Quilcene River tributary. Water from Penny Creek is used for incubation and early rearing. The water temperature is slightly higher than the Big Quilcene River, but exhibits a naturally varying seasonal and diurnal temperature profile.

After eye-up, the eggs are transferred to an incubation and rearing facility located at Big Beef Creek. Water used for incubation and rearing is supplied by a well located approximately ½ mile upstream of the hatchery site. The well also supplies water for a hatchery operated by NMFS for the Redfish Lake sockeye salmon captive broodstock program, and a hatchery fall chinook salmon program operated by the HCSEG using non-indigenous stock. The chinook program is currently authorized by the state and tribal co-managers and conducted under a pay-for-use contract with the University of Washington (the land-owner). The existing well is permitted for the withdrawal of 1200 gpm, but the actual yield from the well is significantly lower, leading to sporadic problems in supplying a sufficient volume of water for the summer chum, sockeye, and fall chinook programs. The summer chum fed-fry program requires up to 180 gpm of inflow to sustain rearing fish at appropriate flow densities at the period near attainment of programmed release size and timing objectives. The NMFS Redfish Lake sockeye program pays the University of Washington for the withdrawal of 600 gpm from the well, and the HCSEG is allotted 300 gpm via payment to the University for the production of fall chinook. An additional factor of concern is that the well, and the water supply line leading to the hatchery pad downstream, have been endangered by flooding in recent years. A new well is being installed closer to the hatchery location, to augment, then replace the existing well. Flows in the Big Beef Creek spawning channel will be supplied, if feasible and as needed, by this new well. The station does, however, have an artesian well that can provide up to 300 gallons/min of water to the channel. The renovated spawning channel will require three to seven cfs to operate efficiently. If drought conditions exist, it may

be difficult to acquire enough surface water to run the channel under ideal flow conditions.

The existing well provides water at a seasonally constant temperature of 10 C, which will generally be warmer (daily and seasonally) than Big Beef Creek water during the majority of the hatchery summer chum salmon incubation and rearing periods (November through March).

4.2) Indicate risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.

At QNFH, hatchery water withdrawal methods will not lead to injury or mortality to listed fish because the Big Quilcene intake structure is screened and Penny Creek intake structures are located above natural barriers to fish migration. Water supply for Big Beef Creek Hatchery is provided by wells. The QNFH operates under a standing NPDES permit that limits discharge effects on the environment, and requires monitoring of effluent for settleable and suspended solids. The Big Beef Creek Hatchery produces a relatively small amount of fish each year, and is well under the 20,000 pounds per year criteria set by WDOE as the limit for concern regarding hatchery effluent discharge effects and for the requirement for an NPDES permit. The NPDES permit and low production levels will likely lead to no adverse effects on water quality from the program on listed fish.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

From 1996 through 1999, broodstock used to supply eyed eggs for the Big Beef Creek reintroduction program have originated from Quilcene stock summer chum under propagation through the Quilcene NFH supplementation program Quilcene stock are collected for the reintroduction program using beach seines in Quilcene Bay and at a fish ladder and permanent trap in the Big Quilcene River at the QNFH. Adult salmon enter the fish hatchery via a concrete fish ladder supplied by production rearing water that is leaving the hatchery. The ladder entrance is positioned at the end of a graduated field electric weir that spans the river. The weir was constructed by Smith-Root Co. in 1989 and forms an electro-mechanical barrier to fish passage. Captured fish are held in the hatchery until their removal for spawning.

Broodstock may be collected at Big Beef Creek beginning with brood year 2000. Two permanent weirs are available for trapping upstream migrating salmonids in the lower Big Beef Creek Basin. A weir and trap operated by WDFW as part of a wild coho salmon productivity study spans lower Big Beef Creek at approximately RM 0.1. A second weir is positioned at the front of a culvert just upstream of the confluence of the Big Beef Creek Hatchery and spawning channel out-fall with Big Beef Creek. In combination, these weirs have the capability of removing all

migrating adult fish attempting to reach spawning areas within the Basin upstream of RM 0.1. Hatchery-origin and wild-origin fish that spawn in Big Beef Creek below RM 0.1 will not be affected by either weir. Both weirs are of picket panel design and possess fish holding boxes equipped with V-shaped entrances. The holding boxes are used to contain fish for future spawning or for eventual upstream passage. In future years, summer chum encountered in the traps will either be released upstream above the Big Beef Creek weir, transported via tank truck for release into the renovated spawning channel, or retained for spawning for the on-going reintroduction program.

5.2) Fish transportation equipment (description of pen, tank truck, or container used).

Adults captured in Quilcene Bay are transported to QNFH by tank truck aerated with regulated oxygen. Moist eyed eggs are transported to Big Beef Creek Hatchery by truck in 5 gallon buckets cushioned by foam pads. Upon completion of rearing, the chum are gathered from the tanks by dipnets or seines, loaded into a truck equipped with a tank or tote and transferred approximately 200 yards before being released into Big Beef Creek at approximately RM 0.1. Beginning in 2000, some adult summer chum encountered in traps at Big Beef Creek may be transported via tank truck for release into a renovated spawning channel (see 5.4).

5.3) Broodstock holding and spawning facilities.

At QNFH, adults are held in a covered concrete raceway at the hatchery until ripe for spawning. Spawning usually occurs within one week of capture. Spawning is accomplished as needed beneath a tent awning to protect the eggs and milt collected from the fish from rain. Although yet to be initiated at Big Beef Creek Hatchery, spawning will be conducted in an area on or near the hatchery pad where eggs and milt procured from spawners can be protected for fertilization.

5.4) Incubation facilities.

At QNFH, fertilized eggs are incubated to the eyed stage in wire baskets suspended in hatching troughs. Once eyed, the eggs are shocked, picked, and incubated to swim-up in vertical stack Heath incubators. Summer chum eggs transferred into Big Beef Creek Hatchery, or taken from returning spawners, for the reintroduction program, will be incubated through swim-up in 55 gallon RSIs designated for the summer chum program. Each RSI may be loaded with up to 75,000 eggs, and supplied with 8-12 gpm flow from the main hatchery water line.

A spawning channel may also be used to help establish Quilcene summer chum by allowing natural spawning and incubation to occur in a protected area that mimics natural conditions. A side channel of Big Beef Creek was originally modified into a 600 foot long by 20 foot wide controlled-flow spawning channel in the late 1960s. This facility was used to produce summer- and normal-time chum salmon for almost twenty years. During the past decade, Big Beef Creek has breached the

side walls of the channel on several occasions and deposited large quantities of silt, mud, and sand into the spawning channel and narrowed its width to 14 feet. The channel was renovated in 1999 by: 1) removing the upper 18 to 24 inches of gravel from the lower 470 feet of the channel, 2) making it 15 feet wide, 3) replacing the removed gravel with 0.25 to 2.0 inch in diameter washed river rock from a nearby quarry, 4) installing six concrete weirs in the channel at 100 foot intervals, and 5) using the material excavated from the channel plus additional fill to repair an existing dike that protects the channel from incursions by Big Beef Creek. These repairs allowed the side channel to once again become a potentially important summer chum salmon production area in the Big Beef Creek basin.

5.5) Rearing facilities.

Fry volitionally leave the RSIs and are collected in fish totes at the base of the RSIs for enumeration and transfer by bucket to 6' diameter fiberglass rearing tanks. If additional funds become available, three 13' diameter fiberglass rearing vessels will replace the ten, six foot tanks currently established at Big Beef Creek. These vessels will allow us to rear summer chum in a more efficient manner than is currently possible. Alternatively six, 16' long by 3' wide by 3' deep fiberglass raceways may be installed. Although these raceways do not have the carrying capacity of the circular tanks they do provide a single pass-through water pathway and consequently may be a preferred rearing vessel shape for chum. The addition of either of these alternative rearing vessels will depend upon the infusion of new funds into this re-introduction program.

5.6) Acclimation/release facilities.

At the appropriate release date, and upon reaching the desired fish release size, chum reared at the facility are gathered from the tanks in seines or dipnets and transferred into a tote box lined with a fine mesh net. The fish are then hauled approximately 200 yards and released into Big Beef Creek just downstream from the weir operated by WDFW. All releases are made during darkness on a falling tide to minimize predation and expedite movement out of the stream. Careful mortality records during incubation and rearing are used to determine the number of fish released per year. This approach, rather than using a gravimetric method at the time of release, is used to estimate the number of fry released per year. It is being employed in an effort to minimize stress during the release process. In addition, the fish are not fed for at least 24 hours prior to being liberated, again in an effort to minimize stress. When the fish are transferred from the tote box to the stream they are gently removed by dip net and placed into 5 gallon buckets which are then hand-carried to the stream. Tank and stream water temperatures are taken to ensure that the fish do not experience a temperature shock at the time of release. If a temperature difference of greater than 2^{o}C exits between the two water types, the fish are adjusted to the stream water by the addition of stream water to the tote prior to being placed into Big Beef Creek.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.

During the first two years of this re-introduction program chum fry were liberated prematurely into the Big Beef Creek estuary. In 1997, storm and tidal events breached the earthen dikes that separate the stream from the spawning channel, rearing tanks, and fish rearing ponds located at the Big Beef Fish Research Station. During that year, chum fry were being reared in net pens located in one of the rearing ponds. Flood waters overwhelmed the net pens in December of 1996 and again in Jan of 1997 and fry were inadvertently released sooner than desired under environmentally challenging conditions. To prevent this from occurring again, fry were reared in a 24' circular tank in 1998. Inexplicably the standpipe for this tank became dislodged and all the fry in the tank were released almost a month earlier than planned. During the 1999 rearing season, three, thirteen foot circular tanks were used. In this case, the stand pipes were locked into place with timbers. In the 2000 rearing period, the thirteen foot circulars were no longer available so ten, six foot diameter tanks were established and chum fry were reared in those tanks. Again all stand pipes were locked in place. No fry losses due to stand pipe failure, disease episodes, or flooding events occurred during the 1999 and 2000 rearing seasons and the fry were released as planned.

5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

At QNFH, trained project personnel live on-station to quickly respond to emergencies. Water supplies are monitored with radio response and dial-up alarm systems. Water is supplied by gravity flow, so it is safe from power outages.

At the Big Beef Creek Fish Research Station, water used for salmon incubation and rearing is supplied by an artesian well which feeds into a main water line. A siphon system for water withdrawal from this well was established in the early 1980s so water flow is not impacted by power failures. However, the siphon line, which is a half mile long, and buried under six feet of earth, is susceptible to flood damage. So far it has not been breached, but during the 1996/97 incubation and rearing period, a portion of the pipe line was exposed due to erosion caused by flooding. Another artesian well dug in the 1970s, can also supply up to 300 gallons per minute of water to the main water line. In the past this well has been used as a backup source of water to the main production well. Unlike the main well, water from this well is withdrawn by an electric pump. A large diesel generator can be used to supply power to the pump if electricity is not available. During the winter of 2000, SRFB monies were used to drill another production well at the University's research station. The new well is located close to the station's hatchery and fish rearing complex and thus its pipeline will not be susceptible to flood damage. The well is still being developed but it is anticipated that it will be able to deliver up to 1,200 gallons of water per minute by the spring of 2000. Like the original production well, a gravity-flow siphon will be installed. In addition, electric pumps will also be placed on the well to ensure that the goal

of 1,200 gallons per minute will be realized. Once this well is on line, water from it will be the primary source for all fish incubation and rearing at the Big Beef station. The diesel generator mentioned above (or a new generator) will provide power to the electric pumps on the new well if normal electric service has been disrupted.

The wells are equipped with low-flow alarm systems which allow station personnel that are on-site to respond and restore flows. Due to the small size of the cumulative Big Beef Creek hatchery programs (under 20,000 pounds total fish production per year), effluent water passing through the hatcheries is not subject to NPDES permit limits. However, all hatchery effluent water is passed through three consecutive 1 acre settling ponds as a measure to remove solids. These components of the Big Beef Creek program relating to water withdrawal through a well and effluent discharge are not likely to adversely affect listed natural summer chum either directly or incidentally.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

6.1) Source.

Beginning in 1996, broodstock used to supply eyed eggs for the Big Beef Creek reintroduction program have originated from Quilcene summer chum under propagation through the Quilcene NFH supplementation program Quilcene summer chum broodstock used for the present reintroduction effort are collected at Quilcene Bay and adults now returning to Big Beef Creek will be allowed to either spawn naturally or be used as broodstock. An intent is to collect adult returns to Big Beef Creek in future years, consistent with the SCSCI objective of using localized broodstock, when established and available to complete reintroduction efforts. Eggs collected from adults returning to Big Beef Creek would replace the need for Quilcene stock egg transfers in the coming years.

Indigenous summer chum broodstock were first collected from Quilcene stock for the supplementation program in 1992. The project is now in its eighth year of operation, and the indigenous population, now of hatchery and natural lineage, continues to be used as broodstock.

6.2) Supporting information.

6.2.1) History.

The indigenous Big Beef Creek summer chum population was extirpated by the early 1980s, and was therefore designated as "extinct" by the Co-managers in the SCSCI (WDFW et al. 2000). The founding population from the Quilcene stock was designated as "depressed" in status by the Co-managers in the SCSCI. As a supplementation effort, the program is designed to increase the numbers of summer chum in the Quilcene stock resulting in recovery of the population; and to provide progeny of Quilcene stock to reintroduce a summer chum population to Big Beef Creek. Prior to initiation of the supplementation program, the Quilcene stock was rated as at high risk of extinction. However, based on an increasing

escapement trend and recent large escapements attributable in large part to the success of the hatchery program, the current extinction risk for this stock is low (WDFW et al. 2000).

6.2.2) Annual size.
The number of broodstock collected is consistent with the guidelines in the SCSCI. The allowable broodstock collection number was initially set so that at least half of the adults returning to Quilcene Bay in any given year would be allowed to escape to spawn naturally; this would limit the effects of the removal of adult fish on abundance and diversity of the naturally spawning population. To achieve fed-fry release goals for programs on Quilcene River and Big Beef Creek, up to 500 adult summer chum (250 females and 250 males) will be collected. The use of broodstock in the supplementation program has already resulted in increased run sizes and natural escapements and changed the risk of extinction from "high" to "low" for this stock (WDFW et al. 2000).

Beginning with brood year 2000, it is proposed to collect broodstock from summer chum adults returning to Big Beef Creek; up to 95 adults (57 males and 38 females) will be collected to achieve fed-fry release goals. If insufficient numbers of adult summer chum return to Big Beef Creek, broodstock collection from Quilcene Bay and QNFH may continue to provide broodstock for the Big Beef Creek program.

6.2.3) Past and proposed level of natural fish in broodstock.
Only summer chum indigenous to the Quilcene stock have been used as broodstock The project is now in its eighth year of operation, and the indigenous population, now of hatchery and natural lineage, continues to be used as broodstock. It is the intention of the program to collect adult returns to Big Beef Creek in future years, consistent with the SCSCI objective of using localized broodstock, when established and available to complete reintroduction efforts.

6.2.4) Genetic or ecological differences.
The indigenous Quilcene stock is the only source of broodstock. Hence, there are no known genotypic, phenotypic, or behavioral differences between the current supplementation stock and the natural stock, but it is being monitored.

6.2.5) Reasons for choosing.
The indigenous Big Beef Creek summer chum population was extirpated by the early 1980s, and was therefore designated as "extinct" by the Co-managers in the SCSCI (WDFW et al. 2000). The indigenous Quilcene summer chum stock was the geographically nearest donor stock, with similar timing and equivalent latitude. No special traits or characteristics were selected for in the broodstock within the indigenous Quilcene stock. It is the intention of the program to collect adult returns to Big Beef Creek in future years, consistent with the SCSCI objective of using localized broodstock, when established and available to complete reintroduction efforts.

6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.

The risk of losing genetic diversity in the Hood Canal and Strait of Juan de Fuca summer chum ESU will be reduced by selecting the geographically nearest available indigenous summer chum salmon population for use as broodstock in reintroduction programs and by limiting its use to only one watershed. All broodstock are to be collected randomly in a manner representative of the timing and magnitude of the return to the creek. No more than 50% of the total number of adult summer chum returning to a donor watershed will be used as broodstock.

SECTION 7. BROODSTOCK COLLECTION

7.1) Life-history stage to be collected (adults, eggs, or juveniles).

Adults

7.2) Collection or sampling design.

For the Quilcene Donor Population:

Beginning in 1996 , methods used to collect broodstock are as follows:

- snorkel survey/block seine collection within freshwater fish migration and holding areas; and
- selective fishery (e.g. beach seine) removal in the targeted stream, or in extreme terminal marine areas immediately adjacent to the mouth of the target stream.
- voluntary entry to the hatchery via the weir and fish ladder.

In Quilcene Bay, beach seine capture of broodstock has depended on the local coho fishery which begins the last week of August through September. The QNFH ladder and trap is in continuous operation from mid-August through December for summer chum, coho, and fall chum broodstock collection.

For Adult Summer Chum Salmon Returning to Big Beef Creek:

At Big Beef Creek, two permanent weirs are available for trapping summer chum adults returning to Big Beef Creek in future years. Eggs will be collected from these adults, supplanting Quilcene-origin transfers, as a measure to promote local adaptation of the Big Beef Creek population. Egg take schedules will be developed that allow for the take of summer chum adults for spawning proportionately, across the total return. Broodstock will also be collected in the traps for transfer to the renovated spawning channel, or release upstream into Big Beef Creek. A schedule will be developed to use returning adults from across the total return. Nearly the entire summer chum return to the creek is available for trapping, decreasing the risk that fish trapped through the program are not representative of the total run. In those years when the total number of summer chum salmon entering Big Beef Creek is less than 100 individuals, every adult will be taken as brood stock. If these fish are unable to produce one-hundred and fifty thousand eyed eggs then eggs from Quilcene will be imported to make up the difference. When monies, staff

support, scheduling (i.e. the University of Washington grants permission to use the structure), and fish abundance allow, summer chum will also be placed into the station's spawning channel. Each channel section can accommodate 30 females and males so a maximum of 240 fish could be placed into the channel. Summer chum salmon not used in these programs will be allowed to spawn naturally in Big Beef Creek.

7.3) Identity.

Big Quilcene River and Little Quilcene River summer chum are mixed in Quilcene Bay, but the two populations are considered one stock. Known hatchery fish (from adipose clipping) will be positively identifiable beginning in 2000 with 3-year old returns from 1997 brood release.

Summer chum adults collected at Big Beef Creek beginning in 2000 are assumed to be returns of progeny of Quilcene stock reared and released at Big Beef Creek beginning in 1996. Thermal marks have been applied to all the summer chum released into Big Beef Creek beginning in 1998 and these marks will be used to assess the effects of different release times on fry-to-adult survival rates in the 1998 brood fish as well as to identify that they were chum liberated from this reintroduction effort. All cultured summer chum subsequently released from Big Beef Creek will be thermally marked for later evaluation and monitoring purposes.

7.4) Proposed number to be collected:

7.4.1) Program goal (assuming 1:1 sex ratio for adults):
250 females plus 250 males for a total of 500 adults collected from Quilcene Bay or QNFH for Quilcene and Big Beef Creek programs combined.

OR: 38 females plus 38 males for a total of 76 adults collected from Big Beef Creek for Big Beef Creek program. If the spawning channel at Big Beef Creek becomes available for summer chum, an additional 240 adults will be collected (30 females and 30 males per channel section).

7.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

Year	Female	Males			
1988					
1989					
1990					
1991					
1992	186	225			
1993	17	19			
1994	178	169			
1995	256	228			
1996	333	438			
1997	261	274			
1998	232	315			
1999	89	83			
2000	201	192			

Note: 2000 includes 11 females and 9 males collected at Big Beef Creek trap

Data source: WDFW et al. 2000, QNFH database, WDFW files. Link to appended Excel spreadsheet using this structure. Include hyperlink to main database)

7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.

The production of surplus eggs or fish is avoided to the extent feasible by limiting the number of adult summer chum secured through broodstock collection operations. Summer chum adults collected in excess of program goals will be returned to Quilcene Bay and/or passed upstream to spawn naturally. Any surplus production will be treated in accordance with protocols set forth in the Summer Chum Salmon Conservation Initiative (WDFW et al. 2000).

7.6) Fish transportation and holding methods.

Adults captured in Quilcene Bay are held in floating live-cars or holding tubes and are transported to QNFH by tank truck aerated with regulated oxygen. During all capture, holding and handling phases, fish are handled with the utmost care, ensuring that harm to the fish, including the duration that chum are out of water, is kept to a minimum. Although not yet initiated, summer chum at Big Beef Creek will be transported via tank truck for release into the renovated spawning channel. Those chum collected for brood stock purposes will either be held in tubes and/or live boxes until ripe.

At QNFH, adults are held in a covered concrete raceway at the hatchery until ripe for spawning. Spawning usually occurs within one week of capture. Spawning is accomplished as needed beneath a tent awning to protect the eggs and milt collected from the fish from rain. Although yet to be initiated at Big Beef Creek Hatchery, spawning will be conducted in an area on or near the hatchery pad where eggs and milt procured from spawners can be protected during fertilization.

7.7) Describe fish health maintenance and sanitation procedures applied.

Fish health monitoring associated with adult fish used in the program is conducted by U.S. Fish and Wildlife Service fish pathologists. The incidence of viral pathogens in summer chum broodstock will be determined by sampling fish at spawning in accordance with procedures set forth in the Salmonid Disease Control Policy (NWIFC and WDFW 1998). Ovarian fluid, kidney, and spleen samples are collected from all fish spawned for evaluation and disease certification purposes.

7.8) Disposition of carcasses.

Returned to Quilcene River for nutrient enhancement or buried on QNFH grounds. Carcasses of summer chum spawned at the Big Beef Creek Hatchery or those allowed to reproduce in the spawning channel will be returned to the Big Beef Creek or the estuary for nutrient enhancement.

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.

The risk of fish disease amplification will be minimized by following Salmonid Disease Control Policy (NWIFC and WDFW 1998) sanitation and fish health maintenance and monitoring guidelines. The indigenous population is the broodstock source. The multi-trait distribution of the broodstock closely matches the multi-trait distribution of the target population (similar spawn timing, size, appearance, age structure, etc.). The broodstock collection is technically and logistically possible.

SECTION 8. MATING

Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.

8.1) Selection method.

Summer chum adults are collected from Quilcene Bay and the QNFH rack across the breadth of the freshwater return period (mid August through October 15), at weekly levels proportional to average escapement timings for the returning population. Methods used to collect broodstock are as follows:

- snorkel survey/block seine collection within freshwater fish migration and holding areas; and
- selective fishery (e.g. beach seine) removal in the targeted stream, or in extreme terminal marine areas immediately adjacent to the mouth of the target stream.

- voluntary entry to the hatchery via the weir and fish ladder.

In addition, once brood stock collection begins in Big Beef Creek, nearly the entire summer chum annual return to the creek will be available to trapping, decreasing the risk that fish trapped through the program are not representative of the total run.

8.2) Males.

At QNFH, backup males are not used; repeat spawning and matrix spawning are used only when insufficient numbers of adults are present to achieve one-on-one spawning. At Big Beef Creek, factorial matings (either 2 x 2, or 3 x 3 crosses) may be used to ensure that the effective population size of this population is maintained. Once a full 38 females and 38 males are collected from returning fish, this practice may be discontinued and replaced with one-to-one matings.

8.3) Fertilization.

The main goals for the breeding of summer chum are for every adult to contribute, and for the genetic contribution from each fish to the population to be as equal as possible. These goals include the desire to minimize loss of alleles and to maintain the heterozygosity present in the existing wild population. In meeting these goals, spawning protocols are applied that ensure that the contributing adults are collected across the breadth of the run (August - October) in proportion to their abundance. By using this strategy the genetic diversity present in the wild stock will be maintained.

Mating schemes used in all summer chum supplementation programs have the objective of incorporating at least 1:1 male-female spawning ratios. Given the preceding goals, and the parameters regarding run timing representation, all matings are randomized with respect to fish age, size, and phenotypic traits. Intentional selection of any particular trait in the use of spawners, including age, size, and other morphological characters, is avoided.

At the Quilcene Hatchery, fertilized eggs are water hardened and surface disinfected for 30 minutes in 75 ppm iodophor solution. They are incubated in baskets set in troughs on ambient Penny Creek water, which ranges in temperature seasonally from 6/ to 12/C. At Big Beef Creek, an identical disinfectant protocol will be used. Newly fertilized eggs will either be incubated in Heath-style incubators or in RSIs.

Adult summer chum are monitored for viral and bacterial pathogens as specified by the Co-Managers' Fish Health Policy. At Big Beef Creek, the weight, length, and age of each fish spawned will be recorded. In addition, reproductive effort, fecundity, and egg size data will be obtained on each female. Moreover, once thermally marked fish return to the station, otolith samples on each spawned fish will be collected.

8.4) Cryopreserved gametes.

None used.

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

A factorial mating scheme or 1:1 individual matings will be applied to reduce the risk of loss of within population genetic diversity for the summer chum salmon population that is the subject of this supplementation / reintroduction program.

SECTION 9. INCUBATION AND REARING -

9.1) Incubation:

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.

Consistent with the SCSCI, the following survival rate objectives for each life stage will be applied to the Big Beef Program. These rates will be used as criteria for measuring the effectiveness of this program.

Chum Life Stage	% Survival by Life Stage	Cum. % Survival from Green Egg
Green egg to eye-up	90.0 %	90.0 %
Eye-up to Swim-up	99.5 %	89.5 %
Swim-up to release	95.0 %	85.0 %

Quilcene National Fish Hatchery:

As indicated above, the summer chum salmon program at the Quilcene National Fish Hatchery began in 1992. Survival from fertilization to the eyed-egg stage has ranged from 80% to 95%, survival from the eyed-stage to yolk absorption or ponding has ranged from 94% to 99%, and overall survival from fertilization to ponding has ranged from 78% to 95%.

Big Beef Creek Fish Research Station:

For the past four years (1996 through 1999), eyed eggs have been brought over to Big Beef Creek from the Quilcene National Fish Hatchery. In 1998, survival data were collected throughout the incubation and rearing period. In this year, 220,000 eyed eggs were brought over to Big Beef Creek and placed into three, 55 gallon RSIs. Eyed-egg to emergent fry survival was 99.2%, survival during the rearing period equaled 99.7% producing a 98.85% survival rate from eyed-egg to fry release. Comparable survival data are being collected for the 1999/2000 incubation and rearing season. Similar data for the 1996 and 1997 egg transfers are not available.

9.1.2) Cause for, and disposition of surplus egg takes.

None anticipated. Any surplus production will be handled consistent with protocols in the SCSCI.

9.1.3) Loading densities applied during incubation.

At QNFH, fertilized eggs are incubated to the eyed stage in wire baskets suspended in hatching troughs. Once eyed, the eggs are shocked, picked, and incubated to swim-up in vertical stack Heath incubators. Incubator trays contain rugose substrate to support the sac-fry during yolk-sac absorption. Heath trays are loaded at a maximum density of 4,000 eyed eggs. Flows into Heath stacks are maintained at 4 gallons per minute to provide the most suitable environment to reduce bacterial loads.

After disinfection with an iodophore solution, eyed eggs transferred from Quilcene are loaded into one of three RSIs at the Big Beef Creek site, supplied with well water at the rate of 8-12 gpm. The RSIs are loaded at low densities (8,000 eggs per RSI screen, up to 70,000 eggs per RSI) for incubation through swim-up. In the future, green eggs fertilized at Big Beef Creek and incubated in the RSIs will be shocked at eye-up, allowing for removal and enumeration of mortalities. Surviving eyed eggs will then be loaded back into the RSIs at low densities. Screens within each RSI are removed as the eggs hatch, allowing enumeration of mortalities. After swim-up, the RSIs are completely emptied to enumerate any additional alevin mortalities and monstrosities. Fry are allowed to volitionally migrate upon swim-up from the RSIs. Emerging fry are collected in fish totes at the base of the RSIs for enumeration and transfer by bucket to rearing vessels in the NMFS Big Beef Creek hatchery compound. The University of Washington and Hood Canal Salmon Enhancement Group are currently building a new salmon incubation facility at Big Beef Creek. This hatchery will be equipped with vertical stack incubators and some summer chum may be incubated in the hatchery in the future.

9.1.4) Incubation conditions.

High quality water sources at QNFH and Big Beef Creek Hatchery pose low or /no siltation risk. Eggs are checked at the eyed-stage of development and protected during early ontogeny (maintained in darkness, mechanical disturbance is avoided, etc.) Temperature regimes have posed no problems during incubation. Dissolved oxygen is not monitored, but no problems have been encountered. At Big Beef Creek, well water is run through columns of bio-rings to aerate it before it is delivered to the fish during their incubation period. Because the well water used for incubation and rearing at Big Beef Creek is warmer and less variable diurnally than ambient water temperatures in the natural incubation environment in the Big Quilcene River and Big Beef Creek, the development of the summer chum eggs at this location will be artificially advanced. The eggs at Big Beef Creek will therefore hatch and swim-up much earlier than their wild counterparts, leading to the potential for diminished survival if the hatchery fish are released as unfed fry, when productivity in the Hood Canal estuarine environment may be low. The 1 to 1.5 month rearing period required to achieve a 1.0 gram average fish size at release planned for the reintroduction program will act to balance this differential in development rate, so that the hatchery fish are released into the environment during the natural summer chum emigration period in March.

9.1.5) Ponding.

As mentioned above, for the foreseeable future, all eggs brought into Big Beef Creek from Quilcene or procured from summer chum returning to the stream will be incubated in RSI's. One of the major advantages of using RSIs for incubating salmonids is that the fish are allowed to volitionally exit from their incubation environment. This means that each individual decides when it should leave its incubation environment and begin exogenous feeding. The duration of the incubation period and stage of development (quantity of yolk still retained) at emergence is affected by egg size and race in chum salmon. For example, fry originating from relatively large eggs usually have more yolk reserves at emergence and a slightly longer incubation period than those originating from smaller eggs. In addition, for a given egg size, summer chum salmon native to Big Beef Creek generally possess less yolk material at emergence than the offspring of chum that spawn in the stream in December and early January. Typically, chum salmon native to Big Beef Creek, regardless of race, require 850 to 920 Temperature Units ^{o}C before emergence.

Mean wet weights were collected on fry at emergence in 1999 and 2000. Fry emerging from RSIs in 1999 weighed around 321 mg, mean weights for the 2000 emergence period have not yet been calculated. In 1999, the fish were ponded from December 30, 1998 through March 4, 1999. In 2000, fish were added to their rearing vessels from 25 Jan through 11 February. As mentioned above, all fry in this program volitionally emerged from their RSIs and were then placed into rearing tanks. If Heath style incubator trays are used to incubate the fish at some future date, fry will be ponded upon absorption of the yolk sack. In addition, K_D values (Bams 1970) obtained on fry as they emerge from RSIs can be used to help determine when fry in these trays should be ponded.

9.1.6) Fish health maintenance and monitoring.

Quilcene Hatchery:

All summer chum are incubated under the guidance of certified fish health personnel from WDFW and/or US FWS and in accordance with the Co-Manager's Fish Health Policy (NWIFC and WDFW 1998). Eggs are water hardened in an iodophore solution at fertilization and at transfer. Fungus in incubators is controlled by formalin drip. Eggs are shocked at eye-up to remove mortalities. At QNFH, the only losses to disease were in the first year of the program, when bacterial gill disease became a problem in tanks have relatively low water flows. Gill bacteria (*Flavobacterium brachiophilus*) are present every year, but are controlled with improved flow management. Causative agents for furunculosis (*Aeromonas salmonicida*) and bacterial kidney disease (*Renibacterium salmoninarum*) are commonly isolated from returning adults, but have not been isolated from hatchery reared juveniles.

Big Beef Creek:

WDFW and U.S. Fish and Wildlife pathologists routinely monitor of the condition and health of summer chum reared at Big Beef. Prior to each release of fed-fry, a comprehensive health examination is performed by U.S. Fish and Wildlife staff. Any disease or health problems observed during the rearing period are reported and pathologists will examine the fish and make recommendations for treatment.

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.
Eggs will be incubated using high quality water to minimize the risk of catastrophic loss due to siltation. Big Beef Station has multiple well-water sources that can be fed into a common water line. If water flow in the primary water source is disrupted for whatever reason, some redundancy is available. In addition, the hatchery is located adjacent to the spawning channel, consequently in extreme emergencies, eggs and alevins could be supplied with channel water, held in the channel or in the settling ponds until well water flow has been restored. All summer chum are incubated under the guidance of certified fish health personnel from WDFW or USFWS and in accordance with the Co-Manager's Fish Health Policy (NWIFC and WDFW 1998); see 9.1.6 above.

9.2) Rearing:

9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available..

Big Beef Creek:

Un-fed fry to fingerling survival was 99.7% during the 1999 rearing period at Big Beef Creek. Pre-mature releases of summer chum fry from Big Beef Creek occurred in 1997 and 1998 and accurate survival estimates are not possible for those years.

9.2.2) Density and loading criteria (goals and actual levels).

Hatchery rearing densities will be those that yield high survival rates and minimize stress. To achieve these cultural objectives, the following conservative "standard" and "maximum" pond loading densities will be applied.

	Pounds fish/gpm inflow volume		Pounds fish/ft3 rearing	
Chum size	**Standard**	**Max.**	**Standard**	**Max.**
Swim-up	<1.0	1.5	0.5	0.75
1200-600/lb	1.0	2.5	1.0	2.0
600-400/lb	1.5	3.0	1.0	2.0

9.2.3) Fish rearing conditions

In 1999, summer chum salmon were transferred from RSI's into 13' diameter fiberglass tanks. Survival and growth in the tanks was excellent, unfortunately the tanks are no longer available for chum rearing. Consequently, for the 2000 rearing period, fry emerging from their RSIs were placed into 6' diameter rearing tanks. A total of 40,000 fry were reared in 2000, and ten rearing tanks, containing 4,000 fish each, were used during this rearing season. The Big Beef Creek summer chum salmon reintroduction program calls for rearing and releasing 103,000 fry per year. To accommodate that number of fry, additional rearing vessels will have to be installed; e.g. either more 6' tanks, or larger circular tanks (e.g. three, 13' diameter tanks) or fiberglass raceways. Currently, we are using 16' long by 3' wide by 3' deep fiberglass raceways to rear chum in

the Lower Columbia River. These vessels can hold twenty to twenty thousand fry each so approximately seven of them would have to be established at Big Beef Creek to meet our fry release goal. Regardless of what type of rearing container is used, rearing densities will be maintained consistent with SCSCI guidelines. The chum will be weight-sampled weekly during rearing to determine fish size and appropriate feeding rates. The fish will be reared in the tanks for 30 to 60 days, until an average size of 1.0-1.5 grams is reached. Summer chum fry originating from the spawning channel will not be reared unless they are used to perform ancillary experiments or research directly related to summer chum restoration.

9.2.4) Indicate biweekly or monthly fish growth information (*average program performance*), including length, weight, and condition factor data collected during rearing, if available.

Growth rate data (change in size per unit of time) *per se*, were not collected during the 1997, 98, or 99 rearing seasons at Big Beef Creek. During the 2000 rearing season, wet fry weights were obtained on randomly sampled fish collected from every rearing vessel used at Big Beef (ten tanks) on a weekly basis. These data will be used to develop growth rate (mg gained/day) estimates for each rearing tank. In 1999 however, length, weight, and Fulton's condition data were collected on 100 fish just prior to each release. These data are displayed below. Comparable release size and condition data will be collected on the summer chum currently being reared at Big Beef during the 2000 rearing period.

Growth rate data (change in size per unit of time) *per se*, were not collected during the 1997, 98, or 99 rearing seasons at Big Beef Creek. During the 2000 rearing season, wet fry weights were obtained on randomly sampled fish collected from every rearing vessel used at Big Beef (ten tanks) on a weekly basis. These data will be used to develop growth rate (mg gained/day) estimates for each rearing tank. In 1999 however, length, weight, and Fulton's condition data were collected on 100 fish just prior to each release. These data are displayed below. Comparable release size and condition data will be collected on the summer chum currently being reared at Big Beef during the 2000 rearing period and for every release year thereafter until the reintroduction program is concluded.

Biol. Parameter	Release 1 23 Feb 99	Release 2 15 Mar 99	Release 3 29 Mar 99
Mean Length	53.8 mm	52.2 mm	58.0 mm
S.D. for Length	3.4	3.9	5.1
95% +	54.5	53.0	59.1
95% -	53.1	51.5	57.0
CV Length	6.3%	7.5%	8.8%
Mean Weight	1.2 g	1.15 g	1.62 g
S.D. for Weight	0.22	0.26	0.48
95% +	1.28	1.21	1.72
95% -	1.19	1.10	1.53
CV Weight	18.52%	22.33%	29.62%
Mean Cond.	.0.79	0.80	0.81
S.D. Cond.	0.04	0.04	0.06
95% +	0.80	0.81	0.82
95% -	0.78	0.79	0.80
CV Cond.	5.66%	5.42%	6.82%

9.2.5) Indicate monthly fish growth rate and energy reserve data (*average program performance*), if available.

Not collected, applicable, nor available. Fry are targeted for release at one gram average size to ensure that fry have sufficient energy reserves.

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).

Quilcene National Fish Hatchery:
Fry are started on Biomoist feed applied at a rate of 2.5 % BW/day using an automatic, 12 hour feeder. Fish weights are sampled weekly to monitor fish growth and to adjust feeding rates. Fish behavior and mortality is recorded daily to monitor the population for fish disease outbreaks.

Big Beef Creek:
At Big Beef Creek, summer chum fry are also fed a Biomoist diet at a rate of 3% body weight per day. The fish are fed six to eight times per day by hand on an ad libitum basis. Daily mortality records are kept on each reared population and weekly samples of fry

weight are taken to adjust feeding rates and to ensure that adequate water flow and exchange occurs.

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures. All summer chum are reared under the guidance of certified fish health personnel from WDFW and in accordance with the Co-Manager's Fish Health Policy (NWIFC and WDFW 1998). Fish are monitored daily during rearing for signs of disease, through observations of feeding behavior and monitoring of daily mortality trends. Preferred and maximum pond loading and feeding parameters are adhered to at all times, as specified in the SCSCI (WDFW et al. 2000). Each year, summer chum fry are examined by a WDFW or U.S. Fish and Wildlife fish health specialist just prior (within 10 days) of release to determine fish health status.

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable. Not applicable.

9.2.9) Indicate the use of "natural" rearing methods as applied in the program. None, however, underwater feeders, overhead cover, and colored rearing vessels may be tried and evaluated in the future if funding for such an evaluation can be procured.

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.

The system that is used to deliver rearing water to the summer chum salmon raised at Big Beef Creek is the same one that supplies the station's incubation water needs. It is derived from a primary well that can currently deliver approximately 700 gallons/min of gravity-fed water. As mentioned above, a new well is being developed at the Station that is designed to supply the facility with up to 1,200 gallons/minute. It should be on line by the spring of 2000. This new well will have a siphon and electric pumping complex to extract water and it will be backed up with a diesel powered generator. Moreover, water from a smaller volume well (approximately 300 gallons/min) can be introduced into the main water line and used to back up the main well when required. If both well systems fail, stream water can be delivered to the rearing vessels via gasoline powered pumps. A battery-driven, audible alarm system is used to alert hatchery staff in the event of water supply failure. The remoteness of the location provides additional security from potential vandalism of the water supply. Uniform rearing methods and a short rearing period are applied across egg take groups to minimize domestication effects. Fry releases occur in the early spring prior to onset of most other salmonid emigration periods and hence the reared fish should not deleteriously impact other listed species that may be in the area.

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

10.1) Proposed fish release levels.

Proposed maximum fish release levels are 86,000 fry at 350-550 fpp during March-May into the estuary at R.M. 0.1 of Big Beef Creek. In addition, a maximum of 200,000 unfed fry released at 1300-1400 fpp during February-April.

Unfed fry numbers represent the potential number of fry that could be produced from the spawning channel, assuming a loading density of 120 females and an egg-to-fry survival rate of 50%. All fry produced from the channel would be released as unfed fish unless research studies utilized some for rearing experiments. In the past, chum fry have been reared at Big Beef Creek up to 120 mm in length ("fingerling"). No immediate plans are in place to do this again, however, the survival of these fish during the rearing phase was high. Moreover a very small proportion of naturally produced chum juveniles stay in freshwater to rear, emigrating at the >75 mm size in the spring; so fish entering seawater at this size represent a rearing strategy that exists in chum. Such fish may be produced at Big Beef Creek in the future to evaluate the effectiveness of a suite of restoration strategies for summer chum

10.2) Specific location(s) of proposed release(s).

Stream, river, or watercourse: Big Beef Creek, WRIA 15.0389
Release point: Big Beef Creek, near mouth at about RM 0.1
Major watershed: Big Beef Creek
Basin or Region: Hood Canal, Puget Sound

10.3) Actual numbers and sizes of fish released by age class through the program.

Data are from SCSCI (WDFW et al. 2000) and WDFW files (1999 and 2000).

Release year	Fry	Avg. size
1997	184,000	0.6 g
1998	100,280	0.8 g
1999	214,936	1.35 g
2000	41,566	1.35 g
Average	135,195	1.0 g

10.4) Actual dates of release and description of release protocols.

At release, all reared fish are dip netted or seined from their rearing vessels, loaded into a net-lined tote box supplied with regulated oxygen, and transported approximately 200 meters to Big Beef Creek. Fry are gently dip netted from the tote box, loaded into five gallon plastic buckets which are hand-carried to the stream, and released into Big Beef Creek, just below the weir at river mile 0.1. All releases occur during darkness, just after

a high tide to minimize predation and potential stranding. No culling occurs during the rearing stage.

In 1996-97 fry were released in December, January, and March; in 1998 a single release occurred on the 9th of February 9. In 1999, 66, 685 fish were released on the 23rd of Feb, 68, 738 fish were liberated on the 15th of March, and 79,513 were released on the 29th of March. In 2000, 41,566 fish were released into the stream on March 10.

10.5) Fish transportation procedures, if applicable.

The transportation methods described in section 10.4 will be used for reared fish. When fry are produced from the spawning channel, they will be captured using fry traps situated at end of each channel section. All individuals emigrating from a channel section will be removed from the traps on a daily basis and gravimetrically counted. They will then be placed into net-lined holding tanks supplied with running water and bubbling air until nightfall. At this time they will be dip netted from their holding tanks, placed into five gallon buckets and hand-carried to Big Beef Creek where they will be released just below the weir at river mile 0.1.

10.6) Acclimation procedures

Direct release into Big Beef Creek.

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

All artificially incubated summer chum fry will be 100% otolith-marked beginning with 1999 brood year releases. If the spawning channel is used to produce summer chum fry those fish can be marked with $SrCl_2 \cdot 6H_2O$ by passive immersion (if the FDA provides an INAD to cover this marking operation). To accomplish this, the water supply feeding into the holding tanks described in section 10.5 will be shut off and $SrCl_2 \cdot 6H_2O$ will be added to each tank's water supply to create a 1000-2500 ppm marking solution of strontium chloride. The fry will be held in this solution for four hours, after which the tank's water supply will be re-started and the marking period will then be completed. During the immersion period, each tank will be aerated to provide the fry with adequate levels of oxygen and to keep the strontium solution well mixed.

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

None anticipated. Any surplus production will be handled consistent with protocols in the SCSCI.

10.9) Fish health certification procedures applied pre-release.

Examination by U.S. Fish and Wildlife or WDFW fish pathologist prior to release.

10.10) Emergency release procedures in response to flooding or water system failure.

A two tiered response will be used. First, if a total water system failure occurs, compressed air and air stones will be placed into the rearing vessels to maintain the fish and all feeding will cease. Alternatively, electric or gasoline powered pumps will be used to re-circulate water in each rearing vessel through a packed column of biorings in an attempt to aerate the water in each tank. If the water failure appears to be one that can be fixed in 24 hrs or less this strategy will be maintained until water flow is restored. During this period, oxygen levels in the vessels will be monitored. If our attempts at aeration are not successful then some of the fish in each tank will be released into Big Beef Creek, and oxygen levels in the tanks will be rechecked to see if adequate oxygen levels are now available for the fish remaining in the tank. Second, if it appears that the rearing vessels themselves are at risk due to flooding, or that it will be impossible to repair the water system, then all fish will be liberated into the Big Beef estuary as quickly as possible. This can be accomplished in two ways, by simply removing the stand pipes in the rearing vessels and letting the fry exit out through the water outlet system or by seining the fish from their rearing vessels and transporting them to the stream for liberation.

At Big Beef Creek, water leaving our rearing vessels enters a holding pond and the water from that pond can either go directly into the estuary or move into two other ponds before entering the estuary. If we have to make a rapid release and pull stand pipes, then the gate valve that allows water to move from this pond to the other two will be closed, and the tide gate in the pond the fish first enter will be opened so that they can directly enter the estuary.

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

The fry are released in the evening, near or at a high tide, to minimize the incidence of avian and fish predation. In addition, fry are fed until they reach 1 to 1.5 grams in size. This is done to ameliorate immediate post-release mortality by allowing the fish to become large enough to escape some predators and to provide them with energy reserves they can use until they become fully adjusted to obtaining natural foods.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

11.1) Monitoring and evaluation of "Performance Indicators" presented in Section 1.10.

11.1.1) Describe plans and methods proposed to collect data necessary to respond to each "Performance Indicator" identified for the program.

It is planned that all "Performance Indicators" identified in Section 1.10 will be monitored and evaluated.

To date, the following "Performance Indicators" **addressing benefits** have monitored for the Big Beef Creek summer chum reintroduction program:

Element 1: Estimate the contribution of supplementation/reintroduction program-origin chum to the natural population during the recovery process.

1. Differentially mark all hatchery-origin summer chum fry to allow for distinction from natural-origin fish upon return as adults on the spawning grounds. This will be accomplished by otolith (thermal) marking or by some other permanent, effective method.
2. Conduct spawning ground surveys throughout the summer chum return to enumerate spawners, and to collect age class composition through scale sampling.

To date, the following "Performance Indicators" **addressing risks** have monitored for the Big Beef Creek summer chum reintroduction program:

Element 3: Determine the need, and methods, for improvement of supplementation or reintroduction operations or, if warranted, the need to discontinue the program.

1. Determine the pre-spawning and green-egg to released-fry survivals for each program at various life stages.
   e. Monitor growth and feed conversion for summer chum fry.
   f. Determine green-egg to eyed-egg, eyed-egg to swim-up fry, and swim-up fry to released fry survival rates for summer chum.
   g. Maintain and compile records of cultural techniques used for each life stage, such as: collection and handling procedures, and trap holding durations, for chum broodstock; fish and egg condition at time of spawning; fertilization procedures, incubation methods/densities, temperature unit records by developmental stage, shocking methods, and fungus treatment methods for eggs; ponding methods, start feeding methods, rearing/pond loading densities, feeding schedules and rates for juveniles; and release methods for fed fry.
   h. Summarize results of tasks for presentation in annual reports.
   i. Identify where the supplementation program is falling short of objectives, and make recommendations for improved fry production as needed.
2. Determine if broodstock procurement methods are collecting the required number of adults that represent the demographics of the donor population with minimal injuries and stress to the fish.
   a. Monitor operation of adult trapping operations, ensuring compliance with established broodstock collection protocols for each station.
   b. Monitor timing, duration, composition, and magnitude of each run at each adult collection site.
   c. Maintain daily records of trap operation and maintenance, number and condition of fish trapped
   d. Collect biological information on collection-related mortalities. Determine causes of mortality, and use carcasses for stock profile sampling, if possible.
   e. Summarize results for presentation in annual reports. Provide recommendations on means to improve broodstock collection, and refine protocols if needed for application in subsequent seasons.

3. Monitor fish health, specifically as related to cultural practices that can be adapted to prevent fish health problems. Professional fish health specialists supplied by WDFW (or U.S. Fish and Wildlife Service for federal agency operations) will monitor fish health.

a. Fish health monitoring will be conducted by a fish health specialist. Significant fish mortality to unknown causes will be sampled for histopathological study.
b. The incidence of viral pathogens in summer chum broodstock will be determined by sampling fish at spawning in accordance with procedures set forth in the Co-Managers Fish Health Policy (NWIFC and WDFW 1998).
c. Recommendations on fish cultural practices will be provided on a monthly basis, based upon the fish health condition of chum fry.
d. Fish health monitoring results will be summarized in an annual report.

11.1.2) Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.

Funding for this program is uncertain. In 1998/1999 monies from SSB 6324 (Fish Enhancement with Remote Site Incubators) managed by WDFW were used to support the summer chum reintroduction effort at Big Beef Creek. These monies were removed by the State Legislature in 1999 and funds from WDFW's Endangered Species Act Recovery Account were used to support the program during the 1999/2000 incubation and rearing season. However, there is not enough money in this account to support the program during the 2000/2001 season. Consequently, an as of yet unidentified source of money will have to be used to continue this effort. Moreover, if Genetic Stock Identification tissues and otoliths are collected, funds for their analysis will be needed.

11.2) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.

It is anticipated that adherence to monitoring and evaluation protocols in the SCSCI will not elevate risk to listed summer chum.

SECTION 12. RESEARCH

*Provide the following information for any research programs conducted in **direct association with the hatchery program described in this HGMP. Provide sufficient detail to allow for the independent assessment of the effects of the research program on listed fish**. If applicable, correlate with research indicated as needed in any ESU hatchery plan approved by the co-managers and NMFS. Attach a copy of any formal research proposal addressing activities covered in this section. Include estimated take levels for the research program with take levels provided for the associated hatchery program in **Table 1**.*

The Big Beef Creek Fish Research Station was established by the Fisheries Research Institute (University of Washington) in the mid 1960s for two main purposes. One was to evaluate the

natural production of coho salmon from Big Beef Creek before and after the development of an artificial lake in the basin (Lake William Symington). The other, and more germane objective was to assess the effects of various gravel compositions, spawner densities, flow rates, and other abiotic and biotic factors on the production of chum salmon in spawning channels. This work was funded largely through grants from the NMFS and Sea Grant. From the mid 1980s until the present, very little research work was done at Big Beef Creek on chum salmon. The falicity's spawning channel was modified for other studies and eventually was severely impacted by flood events which brought in high levels of sand, mud, and fines. Monies from Kitsap County and from the SRFB were used in 1999 and 2000 to renovate the channel so that it could once again be used for chum production and research. Whether it will be used for those purposes depends on two factors, the availability of funds and the interest of University faculty and students. At present, no funds have been earmarked for summer chum restoration research at this facility. The infra structural features of the station, however, make it an ideal location to perform such studies. For example, it would be possible, at this site, to compare the fry-to-adult survival rates of naturally produced fry, channel fry unfed, fed channel fry, unfed RSI fry, fed RSI fry, and fed and unfed hatchery fry. Another obvious question that could be looked at is whether juveniles produced from adults returning to Big Beef Creek have higher survivals than those originating from eggs collected from fish returning to the Quilcene River but brought over to Big Beef Creek. No research studies are scheduled to occur at Big Beef Creek in the near future simply because the monetary resources needed to support such work have not yet been found. Consequently, into the foreseeable future, only basic evaluation and monitoring efforts will occur, and these will occur only if monies can be found to support staff to carry them out.

12.1) Objective or purpose.
Not applicable at this time

12.2) Cooperating and funding agencies.
Not applicable at this time

12.3) Principle investigator or project supervisor and staff.
Not applicable at this time

12.4) Status of stock, particularly the group affected by project, if different than the stock(s) described in Section 2.
Not applicable

12.5) Techniques: include capture methods, drugs, samples collected, tags applied.
Not applicable

12.6) Dates or time period in which research activity occurs.
Not applicable

12.7) Care and maintenance of live fish or eggs, holding duration, transport methods.
Not applicable

12.8) Expected type and effects of take and potential for injury or mortality.
Not applicable

12.9) Level of take of listed fish: number or range of fish handled, injured, or killed by sex, age, or size, if not already indicated in Section 2 and the attached "take table" (Table 1).
Not applicable

12.10) Alternative methods to achieve project objectives.
Not applicable

12.11) List species similar or related to the threatened species; provide number and causes of mortality related to this research project.

Not applicable

12.12) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse ecological effects, injury, or mortality to listed fish as a result of the proposed research activities.

Not applicable

SECTION 13. ATTACHMENTS AND CITATIONS

Allendorf, F.W., D. Bayles, D.L. Bottom, K.P. Currens, C.A. Frissell, D. Hankin, J.A. Lichatowich, W. Nehlsen, P.C. Troter, and T.H. Williams. 1997. Prioritizing Pacific salmon stocks for conservation. Conservation Biology Vol. 11 No. 1 p. 140-152.

Bams, R.A. 1970. Evaluation of a revised hatchery method tested on pink and chum salmon fry. J. Fish Res. Board Can. 27: 1429-1452.

Northwest Indian Fisheries Commission and Washington Department of Fish and Wildlife. 1998. Salmonid Disease Control Policy. Olympia.

Washington Department of Fisheries, Washington Department of Wildlife, and Western Washington Treaty Indian Tribes. 1993. 1992 Washington State Salmon and Steelhead Stock Inventory. Olympia. 212 p.

Washington Department of Fish and Wildlife. 1996. Fish health manual. Hatcheries Program, Fish Health Division, Washington Dept. of Fish and Wildlife, Olympia. 69 p.

Washington Department of Fish and Wildlife and Point-No-Point Treaty Tribes. 2000. Summer Chum Salmon Conservation Initiative. Hood Canal and Strait of Juan de Fuca Region. Jim Ames, Chris Weller, Gary Graves, editors. Fish Program, Washington Department of Fish and Wildlife, Olympia.

SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the foregoing information is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973."

Name, Title, and Signature of Applicant:
Thom H. Johnson, District Fish Biologist, WDFW May 12, 2000

Certified by_____ Date:_____

Table 1. Estimated listed salmonid take levels by hatchery activity.

Listed species affected: Summer chum salmon ESU/Population: Hood Canal Sumer Chum ESU / Big Beef Creek Activity: Reintroduction				
Location of hatchery Quilcene National Fish Hatchery/ Big Beef Creek Hatchery Dates of activity: August - May Hatchery program operator: WDFW, Hood Canal Salmon Enhancement Group, UW(?)				
Type of Take	**Annual Take of Listed Fish By Life Stage *(Number of Fish)***			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)			500	300
Collect for transport b)				
Capture, handle, and release c)			1375	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)			250	
Intentional lethal take f)				
Unintentional lethal take g)			30	
Other Take (specify) h)				

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.
b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
e. Listed fish removed from the wild and collected for use as broodstock.
f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
h. Other takes not identified above as a category.